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METEOROLOGY.—*American temperatures and European rainfall.* W. J. HUMPHREYS, Weather Bureau.

It appears to be very definitely established that the average temperature over the entire earth varies from year to year, that it tends to follow inversely the sun spot cycle—to be lowest at spot maxima and highest at spot minima; that it is invariably decreased by the presence of volcanic dust in the high atmosphere; and that actually it follows closely the resultant of these two influences.[1] If then the average temperature over the earth does vary, it would seem logically certain that many if not all other meteorological elements, such as evaporation (increases with temperature), total precipitation (equals total evaporation), amount of cloudiness, thunderstorm frequency, barometric pressure, total wind movement, and the like, together with all the things that they in turn affect, must also vary according to the same period. But in the case of natural phenomena it often happens that, owing to unsuspected imperfections in the premises, there are surprising differences between the "logically certain" and the "statistically sure." Hence the above inter-relations, however certain one may feel as to what they "ought" to be, are being examined statistically as rapidly as possible, and several interesting results, all confirmatory of natural and simple deductions, have already been obtained, though the investigation as a whole is scarcely more than begun.

[1] Abbot and Fowle. Annals of the Astrophysical Observatory of the Smithsonian Institution, **3**: 211. 1913. Humphreys, Journal Franklin Institute, **177**: 131. 1913. Bulletin Mount Weather Observatory, **6**: 1. 1913.

One of the most interesting of the inter-relations between climatological factors so far shown by this study is the close relation between the annual average temperature of the eastern United States and the total annual precipitation over a large portion of northern Europe. Since the prevailing winds across the North Atlantic are from America to Europe it would seem that when the annual average temperature of the eastern United States is high these winds should reach Europe relatively heavily laden with moisture (evaporation increases rapidly with increase of temperature) and give to it a correspondingly large annual total precipitation. On the other hand, when the annual average temperature of the eastern United States is below normal one might reasonably expect the corresponding annual precipitation of Europe also to be below its normal.

This argument is exactly the same as that which would lead us to anticipate an increase of world-wide precipitation following a universal, or practically universal, increase in the average temperature; but as it applies to well known and restricted regions it is far more easily tested statistically. To this end the averages were taken for each year from 1874 to 1913, inclusive, of the annual average temperatures of 30 rather evenly scattered United States Weather Bureau stations east of the 90th meridian, and the results compared with the average of the annual precipitations at 21 stations widely scattered over Germany. The temperature data were furnished by the Climatological Division of the U. S. Weather Bureau, Mr. P. C. DAY in charge; and the rainfall data from 1874 to 1900, inclusive, were obtained from Hellmann's Die Niederschläge in den Norddeutschen Stromgebieten, volume 1, pages 336 and 337. The subsequent precipitation data were derived from official meteorological publications relative to the same stations in the library of the U. S. Weather Bureau. Both sets of data, the temperature and the rainfall, were "smoothed" according to the equation, commonly used for this purpose,

$$b' = \frac{a + 2b + c}{4}$$

in which b' is the "smoothed" value for the year in question,

and a, b, and c the observed values, respectively, for the next preceding, the actual and the next succeeding year.

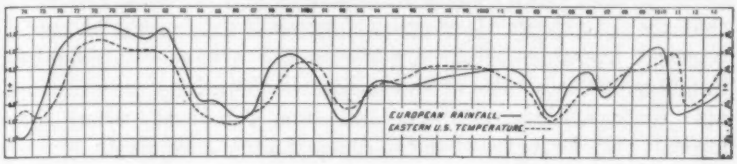

Fig. 1.

The results of this study are represented graphically by the two "smoothed" curves of the accompanying illustration, the one of American (eastern United States) temperatures, the other of European (German) rainfall, or, rather, water equivalent of the total precipitation. Obviously, as the curves show, in this case at least, the statistical results fully support and confirm the previous logical deduction, namely: That high annual average temperatures in America must lead to correspondingly heavy precipitation in Europe and, conversely, that persistently low average American temperatures must be accompanied by more or less correspondingly light European precipitation.

In addition to the rainfall of Germany that of the north slope of the Alps, and also of Holland, were independently examined, and, as might have been suspected, all three found to vary in substantially the same manner.

As above implied, this result is only an earnest of the many important meteorological inter-relations which the complete investigation may reasonably be expected to reveal.

PHYSICS.—*Physically similar systems.* E. BUCKINGHAM, Bureau of Standards.

1. Let n physical quantities, Q, of n different kinds, be so related that the value of any one is fixed by the values of the others. If no further quantity is involved in the phenomenon characterized by the relation, the relation is complete and may be described by an equation of the form

$$\sum M Q_1^{b_1} Q_2^{b_2} \cdot \cdot \cdot \cdot \cdot Q_n^{b_n} = 0 \qquad (1)$$

in which the coefficients M are dimensionless or pure numbers. No purely arithmetical operator, such as *log* or *sin* can be applied to an operand which is not a pure number; and whenever functions that are not expressible as sums of terms of the form (1) occur in physical equations, their arguments are always dimensionless numbers. The results of the indicated operations are therefore also dimensionless numbers, and such functions, when they appear, may be included in the dimensionless coefficients M.

2. Upon dividing equation (1) through by any term we have

$$1 + \sum N Q_1^{a_1} Q_2^{a_2} \cdot \cdot \cdot Q_n^{a_n} = 0 \tag{2}$$

All the terms of a physical equation must have the same dimensions, and the N's are of zero dimensions; hence the exponents a, of each term, must be such that a dimensional equation

$$\left[Q_1^{a_1} Q_2^{a_2} \cdot \cdot \cdot Q_n^{a_n}\right] = [1] \tag{3}$$

is satisfied.

Let π represent any dimensionless product of the form defined by equation (3). Then π^x is also dimensionless; and if $\pi_1, \pi_2, \ldots\ldots \pi_i$ are all the independent dimensionless products which can be made by combining powers of the Q's, equation (2) may still satisfy the dimensional requirement by having the more general form

$$1 + \sum N \pi_1^{x_1} \pi_2^{x_2} \cdot \cdot \cdot \cdot \pi_i^{x_i} = 0 \tag{4}$$

Since the number of terms and the values of the N's and x's are indeterminate, the Σ is merely some entirely unknown function of the independent arguments $\pi_1, \pi_2, \ldots\ldots \pi_i$. Hence the most general form that equation (1) can have, subject to the dimensional conditions, is

$$\Psi(\pi_1, \pi_2, \cdot \cdot \cdot \cdot \pi_i) = 0 \tag{5}$$

3. Let k be the number of fundamental units needed in an absolute system for measuring the n kinds of quantity: then among the n units required, there is always at least one set of k which are independent and not derivable from one another, and which might therefore be used as fundamental units, the remaining

$(n-k)$ being derived from them. Let $[Q_1],....[Q_k]$ be such a set, and let $[Q_{k+1}],....[Q_n]$ be denoted by $[P_1],....[P_{n-k}]$. Each unit $[P]$ is connected with or derivable from the $[Q]$'s by a dimensional equation which may be written in the form

$$\left[Q_1^{\alpha} Q_2^{\beta} \cdot \cdot \cdot \cdot Q_k^{\kappa} P\right] = [1] \tag{6}$$

Since there are $(n-k)$ of the P's, there are $(n-k)$ independent equations of this sort, and no more.

If in equation (6) we substitute for $[P]$ and the $[Q]$'s their dimensional equivalents in terms of any convenient fundamental units—which will necessarily be k in number—the requirement that the exponent of each fundamental unit shall vanish separately furnishes k independent linear equations which suffice for the determination of the exponents α, β, etc. If, after determining these exponents for any particular $[P]$, we set

$$\pi = Q_1^{\alpha} Q_2^{\beta} \cdot \cdot \cdot Q_k^{\kappa} P \tag{7}$$

π satisfies the condition of being a dimensionless product of the required form. There are $(n-k)$ independent equations of the form (6), one for each of the quantities P, and the same number of independent π's; hence $i=n-k$.

4. We have hitherto confined our attention to a relation among quantities that are all of different kinds. If several quantities of any one kind are involved in the relation to be described, they may all be specified by the value of any one and the ratios r', r'', etc., of the others to that one. Dimensional considerations cannot tell us anything about the manner in which these dimensionless ratios r appear in the equation which describes the relation; but their possible influence must be indicated, and this may be done in an entirely general way by introducing them as additional independent arguments of the unknown function Ψ. The limitation imposed by the requirement of dimensional homogeneity upon the possible forms of physical equations may therefore be conveniently summarized in the following statement:

Any complete physical equation which describes a relation subsisting among quantities of n different kinds, of which k kinds are

independent and not derivable from one another, is reducible to the form

$$\Psi(\pi_1, \pi_2, \cdots \pi_{n-k}, r', r'', \cdots \text{etc.}) = 0 \tag{8}$$

in which the r's are all the independent ratios of quantities of the same kind, and each π is determinable from an equation of the form

$$[\pi] = \left[Q_1^{\alpha} Q_2^{\beta} \cdots Q_k^{\kappa} P\right] = [1] \tag{9}$$

The independent arguments of Ψ in equation (8), including both the π's and the r's, are *all* the independent dimensionless products of powers of *all* the quantities involved in the relation, whether of different kinds or not. If the whole number of quantities is h, the number of these independent arguments is $(h-k)$. Hence any complete physical equation is reducible to the form

$$\Psi(X_1, X_2, \cdots X_{h-k}) \tag{10}$$

in which the X's are all the possible independent dimensionless combinations of powers of all the quantities involved.

5. In practice, the r's are evident upon inspection of the whole list of quantities; there is therefore no occasion for finding them from equations of the form (9), and equation (8) is more convenient than the symmetrical form (10), which does not distinguish between the r's, which are pure ratios with absolute numerical values, and the expressions π which, while dimensionless and independent of the sizes of the fundamental units of our system, do depend on the definitions according to which the derived and fundamental units of the absolute system are connected.

It often happens that one or more of the π's are also evident upon inspection. In this event, only the remaining π's need be found by the routine process of solving equation (9) for the exponents.

When the solution of equation (9) results in a value of π which is inconvenient to write, we are at liberty to replace the expression found, by any function of itself: for this new expression will still be dimensionless and independent of the other π's. This remark enables us to dispense with the fractional exponents which sometimes result from the solution of equation (9).

6. If equation (8) is solved for any one of the π's, e.g. π_1 it may be written in the form

$$P_1 = Q_1^a Q_2^b \cdot \cdot \cdot Q_k^\kappa \varphi(\pi_2, \pi_3, \cdot \cdot \cdot \pi_{n-k}, r', r'', \cdot \cdot \cdot) \quad (11)$$

in which

$$a = -\alpha_1, \; b = -\beta_1, \text{ etc.}$$

If it is desired to obtain an equation of the form (11) with a particular quantity P_1 appearing separately and in the first member only, it is evident that this quantity must, from the start, be excluded from the list of quantities to be used as the $[Q]$'s in equation (9). It will then act as a $[P]$, will appear in only a single π, and will be separable.

Equation (8) may also, of course, be solved for any one of the r's, such as r', and put into the form

$$r' = \varphi(\pi_1, \pi_2, \cdot \cdot \cdot \pi_{n-k}, r'', r''', \cdot \cdot \text{ etc.}) \quad (12)$$

which is sometimes useful.

7. Since equation (11) contains an unknown function φ, the form of which can not be found by dimensional reasoning, the equation does not give us any definite information in the general case when all the quantities involved in the second member vary arbitrarily. If, however, all the r's are held constant; and if the variations of the Q's and of $P_2, \ldots P_{n-k}$ are not entirely arbitrary but subjected to the $(n-k-1)$ conditions that $\pi_2, \ldots \pi_{n-k}$ shall remain constant; then we do have a definite statement of the dependence of P_1 on the Q's. For under these circumstances, although its general form remains unknown, the function φ degenerates into a dimensionless constant N, because its arguments are all constant. Hence equation (11) assumes the definite form

$$P_1 = N Q_1^a Q_2^b \cdot \cdot \cdot Q_k^\kappa \quad (13)$$

A single measurement of simultaneous values of P_1 and the Q's suffices to determine the numerical value of N; and by equation (13) with this value of N, the value of P_1 may be computed for any values of the Q's without further experiment.

The chief value of the principle of dimensional homogeneity is found in its application to problems in which it is possible to arrange matters so that the r's and π's of equation (11) shall remain constant and the definite equation (13) therefore be satisfied.

8. The quantities involved in a physical relation pertain to some particular physical system which may usually be treated as of very limited extent. Let S be such a system, and (11) the equation which describes a relation subsisting among certain quantities of the kinds Q and P which pertain to S, e.g. the sizes, densities, thermal conductivities, etc. of its essential parts.

Let S' be a second system into which S would be transformed if all quantities of each kind Q involved in equation (11), were changed in some arbitrary ratio, so that the r's for all quantities of these kinds remained constant, while the particular quantities Q_1, Q_2,....Q_k changed in k independent ratios. For example; if Q_1 is a length, S and S' are to be geometrically similar in all their essential parts, though other parts, of which the size and shape have no influence on the relation under consideration, are not subject to any geometrical conditions. The systems now "correspond" as regards their essential parts and may be said to be similar as regards each of the kinds of quantity Q separately, so far as such quantities are involved in equation (11).

In addition to the foregoing specifications, which relate to the changes of the Q's during the transformation of S into S', let P_2 and all quantities of that kind involved in the relation, change in such a ratio, dependent on the *arbitrary* changes of the Q's, that π_2 remains constant; and let similar conditions be imposed on P_3, P_4,....P_{n-k}, and all quantities of those kinds involved in the relation. Two systems S and S' which are related in the manner just described are similar as regards the physical relation in question.

If two systems correspond in the manner described for the k independent kinds of quantity Q, and if it is practicable to make them similar by fulfilling the conditions which relate to the quantities of the kinds P, equation (13) is satisfied by the quantities pertaining to either system, and the value of N determined by experiment on one system may at once be used for the other.

A particular form of this theorem, known as the principle of "dynamical similarity" is in familiar use for the interpretation of experiments on mechanical models; but the theorem is equally applicable to problems in heat and electromagnetics.

PHYSICAL METALLURGY.—*Observations on finishing temperature and properties of rails.*[1] G. K. BURGESS, J. J. CROWE, H. S. RAWDON, and R. G. WALTENBERG, Bureau of Standards.

Observations were taken with an optical pyrometer of ingot and finishing temperatures of rails in four representative mills. There is practical uniformity among the several mills for the rolling temperatures of ingots for steel rails, the range being from 1080°C. (1975°F.) to 1140°C. (2085°F.). There is no very considerable difference among the finishing temperatures of the rails as observed at the hot saws for the several mills, the range being about 880°C. (1615°F.) to 990°C. (1815°F.). Or, in other words, the four mills all finished their rails to within 50°C. of 935°C. (1715° F.) on the average. This temperature of 935°C. is 270°C. (520°F.) above the mean value, 665°C. (1230°F.) of the critical ranges of these rail steels. Concerning the distribution of temperature within the head of a cooling rail, it is shown that the center of the head is some 50°C. (120°F.) to 60°C. hotter than the optical pyrometer reading at 935°C.; therefore the center of the head is finished, on the average, at about 325°C. (615°F.) above the critical range for 100 lb. sections.

Chemical analyses and microphotographic examinations were also made and the mechanical properties determined for a number of samples of rail, the rolling of which had been observed. From a comparison of these few observations there appears to be not a sufficient degree of correlation to warrant associating very speci-

[1] This is a summary of a paper to be published shortly in full as a Technologic Paper of the Bureau of Standards with the following contents: 1. Introduction; 2. Importance of Limiting Temperatures of Rolling Rails; 3. Methods of Measuring Rail Temperatures; 4. Wickhorst's Experiments; 5. Measurements of Ingot and Finishing Temperatures; 6. The Samples and Chemical Analyses; 7. Mechanical Properties of Rails; 8. Melting Temperatures of Rail Steels; 9. The Critical Ranges of Rail Steels; 10. Observations on the Microstructure; 11. Temperature Distribution in a Cooling Rail; 12. The Expansion of Rail Steels; 13. The "Shrinkage Clause" in Rail Specifications; 14. Summary and Conclusions.

fically any of the characteristics defined by these three methods of examination, either with the temperatures of rolling here observed or with each other.

The following thermal properties of these rail steels were determined in the laboratory: The critical range on heating is located (maximum) to within 7°C. of 732°C. (1350°F.) for the 10 samples of O.H. and Bessemer steels examined. On cooling, the critical range lies between the limits 680°C. (1256°F.) and 650°C. (1202°F.). The melting or freezing range for rail steel extends from about 1470°C. (2680°F.) to nearly the melting point of iron, located at 1530°C. (2786°F.).

The expansion for O.H. and Bessemer steels is not the same. Above 800°C. (1470°F.) the expansion for both increases linearly with temperature, and the linear coefficient per degree centigrade has the following mean values between 0° and 1000°C.:

(1) For Bessemer Steel (Carbon .40 to .50 per cent): $\alpha = 0.0000146$
(2) For Open Hearth Steel (Carbon .65 to .70 per cent): $\alpha = 0.0000156$ to 0.0000161.

The average composition of the Bessemers was carbon = 0.40 to 0.50 and maganese = 0.76 to 0.93; of the Open Hearths, carbon = 0.65 to 0.70 and manganese = 0.66 to 0.72.

In 1909 the American Society for Testing Materials limited the shrinkage allowance on 100 lb. sections to $6\frac{3}{4}$ inches in 33 feet, or to an equivalent of 1947°F. (1064°C.) for O.H. and 2055°F. (1124°C.) for Bessemer rails, a specification which is still in force. Such a shrinkage clause, therefore, does not serve the avowed purpose of limiting the finishing temperatures to a value slightly above the critical range.

MINERALOGY.—*Mineralogical notes, Series 3.* WALDEMAR T. SCHALLER, U. S. Geological Survey.

A bulletin with this title has been submitted for publication by the U. S. Geological Survey. In order to secure priority, the following very brief abstracts are given of the original papers:

Koechlinite (Bismuth Molybdate), A New Mineral from Schneeberg, Saxony, is named after Dr. RUDOLF KOECHLIN of Vienna. The orthorhombic ($a : b : c = 0.9774 : 1 : 1.0026$) crystals are

thin tabular parallel to a {100}. Formula: $Bi_2O_3.MoO_3$. *Inyoite and Meyerhofferite, Two New Calcium Borates* from Death Valley, Inyo County, California, belong to the colemanite series. *Inyoite* (named after the locality) occurs in rhombic-shaped monoclinic crystals ($a : b : c = 0.9408 : 1 : 0.6665$, $\beta = 62°37'$). The formula is $2CaO.3B_2O_3.13H_2O$. The *inyoite* crystals alter to aggregates of prismatic crystals of *meyerhofferite* (named after W. MEYERHOFFER, who made the mineral artificially), which is triclinic ($a : b : c = 0.7923 : 1 : 0.7750$, $\alpha = 89°32'$, $\beta = 78°19'$, $\gamma = 86°52'$) and which has the formula $2CaO.3B_2O_3.7H_2O$. *Lucinite a New Mineral: A Dimorphous Form of Variscite,* occurs with variscite at Lucin, Utah, in minute octahedral orthorhombic crystals.

Lucinite, $a : b : c = 0.8729 : 1 : 0.9788$
Variscite, $a : b : c = 0.8944 : 1 : 1.0919$

Analyses show the two minerals to have the same composition. *The Crystallography of Variscite* includes a redetermination of the axial ratio (just given) and an extension of the crystal forms. *Schneebergite:* A study of original material from Schneeberg, Austrian Tyrol, loaned by DR. KOECHLIN of Vienna, has shown it to have the formula $4CaO.Sb_2O_3.Sb_2O_5$, the antimony being present in two states of oxidation. Schneebergite is distinct from all other calcium antimony compounds. *Romeine* from Italy has the formula $5CaO.3Sb_2O_5$. The so-called atopite from Brazil is not that mineral but romeine. *The Natural Antimonites and Antimonates* are briefly classified. *Velardeñite, a New Member of the Melilite Group,* is tetragonal, and has the composition $2CaO.Al_2O3.SiO_2$. The so-called gehlenite from Velardeña, Mexico, is velardeñite. *The Melilite Group* of minerals can be interpreted as mixtures of velardeñite, sarcolite ($3CaO.Al_2O_3.3SiO_2$), and åckermanite ($4MgO.8CaO.9SiO_2$). *The Crystallography of Thaumasite* describes hexagonal crystals, $c = 1.09$. The *Chrysocolla Group* discusses the minerals commonly called chrysocolla which are shown to belong to several distinct crystallized species. *The Chemical Composition of Tremolite* is considered from the chemical side and the probable formula derived for the mineral is $H_2O.2CaO.5MgO.8SiO_2$. *The Probable Identity of Mariposite and Alurgite* is considered, and *The Amblygonite Group*

of Minerals: *Fremontite* = *Natramblygonite* withdraws the name natramblygonite and substitutes for the mineral $Na(AlOH)PO_4$ the name *fremontite*, after Fremont County, Colorado.

BOTANY.—*Acacia cornigera and its allies.* WILLIAM EDWIN SAFFORD, Bureau of Plant Industry.

In the course of a recent study of the myrmecophilous Acacias in the U. S. National Herbarium the author encountered a number of undescribed species, some of which differ fundamentally from any hitherto known. Much confusion was found also in the existing classification of these plants, due largely to the fact that, in describing species, the early authors had failed to designate definite types. Thus, under *Acacia cornigera* (*Mimosa cornigera* L.) several distinct species were cited by Willdenow as possible synonyms, a fact which was recognized by Schlechtendal and Chamisso in their study of certain specimens collected in Mexico by Schiede. But these authors in turn included under their *Acacia sphaerocephala* two, if not three species, one of which has recently been described by Dr. Heinrich Schenck, of Darmstadt, under the name *Acacia veracruzensis*. To make the confusion still greater, Bentham in his Revision of the Mimoseae,[1] "redescribed" *Acacia sphaerocephala* and *A. spadicigera* but applied these names to species quite distinct from those so-called by Schlechtendal and Chamisso, while he dropped *Acacia cornigera*, a species distinct from both *A. sphaerocephala* and *A. spadicigera*, based upon a plant growing in the garden of George Clifford, a specimen of which exists in the Linnaean Herbarium (no. 4). The synonyms cited by Bentham are even more heterogeneous than those of Linnaeus.

The absence of flowers and fruits from the specimens of myrmecophilous Acacias described by the early botanists has been the chief cause of the mistakes of later authors. Fortunately the material in the U. S. National Herbarium includes specimens of fruits as well as of flowers of nearly all the species. The present writer recognized the fact that these fruits, which are of several distinct forms, offer a means of separating the species into a

[1] Trans. Linn. Soc. Lond. **30**. 1875.

number of well defined natural groups. When it came to his notice that Dr. Schenck was also engaged in studying the myrmecophilous Acacias, the writer postponed the publication of his paper in deference to Dr. Schenck, from whom he received a most courteous acknowledgment.[2]

Dr. Schenck based his classification principally upon the venation of the leaflets and upon the general form of the inflorescence. In his material fruits of several species were lacking. On the receipt of photographs of further specimens of his newly established species, many of which included seed pods, Dr. Schenck realized the importance of using the latter as a basis for natural classification.[3] As it has become necessary to defer the publication of the writer's monograph of the myrmecophilous Acacias, it is thought advisable to offer the present preliminary paper, in which a classification of the group is presented together with descriptions of nine new species.

KEY TO THE GROUPS

Involucre situated near the base or at least below the middle of the peduncle; interfloral pedicelled bracteoles peltate; spines glabrous
- Pericarp indehiscent, inflated, terminating in an acute spine-like beak..... I. CERATOPHYSAE.
- Pericarp dehiscent
  - Fruit a pod, opening by a dorsal and a ventral suture
    - Flowers in globose heads; pods sometimes very long and slender... II. GLOBULIFERAE.
    - Flowers in cylindrical spikes; pods short and relatively broad..... III. LEGUMINIFERAE.
  - Fruit a follicle, opening by a single suture. IV. FOLLICULARES.

Involucre situated at or above the middle of the peduncle, the latter pubescent or hirtellous; interfloral pedicelled bracteoles not peltate; spines puberulent when young... V. HEBACANTHAE.

[2] See H. Schenck, "Die myrmekophilen Acacia-Arten," Bot. Jahrb. Engler **50**: 449–487. 1914.

[3] "Die Beschaffenheit der Früchte dürfte vielleicht zur endgültigen Unterscheidung der Artengruppen der Ameisenakazien mindestens ebenso wichtige, vielleicht noch bessere Anhaltspunkte geben wie die Form der Inflorescenzen." Bot. Jahrb. Engler **50**: 480. 1914.

GROUP I. CERATOPHYSAE[4]

Pericarp indehiscent, inflated, thin, fragile, terminating in a sharp spine-like beak. Nectar glands of the petiole and often of the lower rachis, elongated, crater-like, opening by a linear aperture with a raised (marginal) rim.

Section 1. **Spadicigerae** Schenck

Flowers in spadix-like cylindrical spikes, densely crowded on a fusiform receptacle; peduncles thickened, bearing a 4-parted calyx-like involucel near the base; minute interfloral pedicelled bracteoles with peltate, acuminate laminae, in form often resembling the leaf of an Arum. Midrib and upcurved lateral nerves of the leaflets usually conspicuous beneath.

1. **Acacia spadicigera** Schlecht. & Cham. Linnaea **5**: 595. 1830; not *Acacia spadicigera* Benth. Trans. Linn. Soc. London **30**[3]: 514. 1875.

Type in the Halle Herbarium, collected near La Laguna Verde, State of Veracruz, Mexico, in March, 1820, by Schiede (no. 685). Photograph and fragments of type in the U. S. National Herbarium.

2. **Acacia cubensis** Schenck, Repert. Nov. Sp. Fedde **12**: 360. 1913.–Bot. Jahrb. Engler **50**: 460. 1914.

Type in the West Indian Herbarium of Krug and Urban, Berlin, collected in northern Cuba, April 21, 1863, by C. Wright (no. 2402); specimens collected by C. Wright, bearing the same number, in the Grisebach Herbarium, Göttingen, and in the Gray Herbarium.

3. **Acacia Hernandezii** sp. nov.[5] Closely related to *Acacia spadicigera* Schlecht. & Cham. and *A. nicoyensis* Schenck, but readily distinguished from the former by the subsessile flower spikes, scabrous before anthesis owing to the recurved points of the bracteoles; and from the latter by the color of the spines and the fewer nectar glands. Large spines of the vegetative branches resembling the horns of a bull, subterete, widely spreading or incurved, sometimes fascicled and interlocking as in *A. spadicigera*, but never polished, at first pale brown or olivaceous, in age chestnut-colored or, when dead, grayish brown, the largest 8 to 10 cm. long, 1.8 cm. broad at the base. Spikes borne on axillary flowering branches like those of *A. spadicigera*, often subsessile, solitary or geminate, subtended by small leaves, these with subulate stipular spines; peduncles puberulent, 2 to 5 mm. long, 3 mm. thick, with 4-toothed basal involucel like that of *A. spadicigera*. Flowers before anthesis covered by the laminae of the bracteoles, these lanceolate, very long-acuminate, peltate, scabrous on the upper surface, the margin bearing a fringe of minute straight hairs, the pedicels usually somewhat hirtellous with fine white diaphanous hairs visible under the microscope; apices of the

[4] Acaciae americanae cornigerae siliquis in spinam abeuntibus. See Hermann, Paul. Paradisi Batavi Prodromus, p. 303. 1689.

[5] The Huitzmamaxalli ("forked-thorn") of the Aztecs, described and figured in 1576 under the name *Arbor cornigera* by Francisco Hernández.

bracteoles recurved. Calyx broadly tubular, resembling that of *A. spadicigera*, ferruginous, the upper portion sparsely hirtellous; corolla barely exceeding the calyx, the aperture splitting at anthesis into 5 or 6 divisions. Fruit inflated, indehiscent, terminating in a slender sharp beak, narrowed at the base into a stipelike neck, glabrous, smooth, olive green when young, at length bright wine-colored. Seeds 12, in 2 series, broadly ovoid, compressed, embedded in a mass of sweetish pulp; testa hard, smooth, dark brown. Leaves closely resembling those of *A. spadicigera*, those of the vegetative branches with 7 to 12 pairs of pinnae; elongated nectar gland on the petiole crater-like, placed at the base of the basal pair of pinnae, sometimes with a smaller raised cylindrical gland below it, and rarely with a second, somewhat elongated gland at the base of the second pair of pinnae; leaflets 17 to 29 pairs, linear-oblong, unequal at the base, the midrib and upcurving lateral nerves conspicuous beneath, as in *A. spadicigera*. Leaves of the inflorescence smaller; pinnae 2 to 5 pairs, the petiole bearing 1 or 2 raised glands, a gland often present also at the base of the second pair of pinnae.

Type in the U. S. National Herbarium, no. 692170, collected in the vicinity of Rascon, State of San Luis Potosí, Mexico, July 19 to 22, 1905, by Dr. Edward Palmer (no. 669).

4. **Acacia furcella** sp. nov. Related to *Acacia spadicigera* and *A. Hernandezii*, but having polished black or dark brown, forklike spines with subcuneiform base and erect, slightly diverging or subparallel prongs, much abbreviated or suppressed flowering branchlets, and spikes crowded in clusters. Base of spines 12 to 16 mm. broad, the prongs terete, 50 to 60 mm. long, long-acuminate at the apex. Flowers densely crowded, resembling those of *A. spadicigera*, but more densely hirtellous. Spikes cylindrical 30 to 40 mm. long; receptacle (axis of spike) fusiform, 6 to 8 mm. thick when mature; peduncles 10 to 14 mm. long, 2 to 4 mm. thick; involucre basal, 4-toothed, similar to that of *A. spadicigera*. Calyx ferruginous, 1.4 mm. long, 0.6 mm. broad at anthesis, thickly covered with minute short straight projecting hairs; corolla 4 to 6-lobed, slightly longer than the calyx. Interfloral bracteoles brown, the laminae ovate-acuminate, peltate, sagittate at the base, scabrous above, edged with minute short straight marginal hairs. Fruit wanting. Leaves of vegetative branches not observed; those of flowering branches with 3 to 5 pairs of pinnae; rachis puberulent, 4 to 6.5 cm. long; nectar glands similar to those of *A. Hernandezii;* leaflets 13 to 24 pairs, 9 mm. long, 2 mm. broad, reddish brown when dry, the midrib and lateral nerves prominent beneath as in *A. spadicigera*.

Type in the U. S. National Herbarium, no. 692166, collected on the shore of Lake Catemaco, southern Veracruz, Mexico, at an elevation of 1000 feet, April 26, 1894, by E. W. Nelson (no. 427).

5. **Acacia nicoyensis** Schenck, Repert. Nov. Sp. Fedde **12:** 360. 1913.—Bot. Jahrb. Engler **50:** 463. 1914.

Type in the Berlin Herbarium, collected on the shore of the Gulf of Nicoya, Costa Rica, in February, 1900, by A. Tonduz (no. 13538); duplicate of type in the U. S. National Herbarium, no. 577752.

Section 2. Dolichocephalae

(*Sphaerocephalae* Schenck, in part)

Flowers in spheroid or oblong heads having a thick peduncle and ovoid or oblong receptacle; interfloral bracteoles with glabrous pedicels and ovoid, obtuse, usually ciliate laminae. Leaflets usually with only the midrib conspicuous beneath. Nectar glands of the petiole resembling those of the Spadicigerae.

6. **Acacia sphaerocephala** Schlecht. & Cham. Linnaea **5**: 594. 1830; not *Acacia sphaerocephala* Benth. Trans. Linn. Soc. London **30**[3]: 514. 1875.

Type in the Berlin Herbarium, collected at Actopan, State of Veracruz, Mexico, in March, 1820, by Schiede (no. 684), with flowers and leaves; photograph and fragments of the type in U. S. National Herbarium.

7. **Acacia cornigera** (L.) Willd. Sp. Pl. **4**: 1080. 1806 (excl. synonyms).

Type in the Linnaean Herbarium[6] from a cultivated plant growing in the garden of George Clifford, between Haarlem and Leyden, Holland, collected by Linnaeus (no. 4) and bearing his label, "*Mimosa cornigera.*"

8. **Acacia veracruzensis** Schenck, Repert. Nov. Sp. Fedde **12**: 362. 1913.—Bot. Jahrb. Engler **50**: 477. 1914.

Type in Herb. Mex. Schenck, collected on sand dunes south of the city of Veracruz, Mexico, October, 1908, by H. Schenck (no. 916); fragments of the type in the U. S. National Herbarium.

GROUP II. GLOBULIFERAE

(SPHAEROCEPHALAE Schenck, in part)

Pericarp dehiscent, coriaceous or woody, more or less compressed, sometimes very long and slender, opening by ventral and dorsal sutures. Flowers in long-peduncled globose heads, with spheroid receptacle.

Section 3. Ramulosae

Flower heads borne in the axils of small subulate stipular spines on special flowering branchlets.

9. **Acacia globulifera** sp. nov. Flowers in small globose heads not exceeding 5 mm. in diameter at anthesis, clustered in 2's or 3's on solitary axillary branchlets 4 to 6 cm. long; peduncles in each cluster graduated in length, the longest at anthesis about twice as long as the diameter of the head; receptacle spheroid or broadly ovoid, not sharply constricted

[6] The writer is indebted to Dr. Alfred Barton Rendle of the British Museum of Natural History for a photograph of the type of *Acacia cornigera* (L.) Willd. A careful comparison of this with photographs and portions of the types of *A. spadicigera* and *A. sphaerocephala* proves that Linnaeus's original plant is specifically distinct from both. It resembles an Acacia collected on the shore north of the city of Veracruz, January 24, 1906, by Dr. J. M. Greenman (no. 87), allied to *A. sphaerocephala* Schlecht. and Cham., but differing from that species in its extrafloral nectaries and in the shape of the flower heads.

at its union with the thickened upper extremity of the peduncle. Flowers about 2.2 mm. long when mature, funnel-shaped, the calyx with usually 5 shallow rounded lobes, glabrous near the base, puberulous about the margin; corolla about one-fourth longer than the calyx and distinctly separate from it, usually acutely 6-lobed, coarsely puberulent outside. Interfloral pedicelled bracteoles with orbicular peltate laminae. These subentire or the margin shallowly and obtusely toothed. Fruit not observed. Large spines ivory white or ecru, V-shaped or spreading like the horns of an ox, terete, 4 to 5 cm. long, 7 mm. broad at the base. Small spines of the flowering branchlets acicular or subulate, 7 mm. long. Vegetative leaves with 6 to 10 pairs of pinnae, the rachis 6 cm. long or less (in the type material), puberulent, bearing a row of 2 to 7 conoid nectar glands below the basal pair of pinnae, the glands having a porelike opening surrounded by a smooth, whitish, circular or elliptical, annular margin; pinnae 15 mm. long or less; leaflets of the longer pinnae 18 to 26 pairs, 3.5 mm. long, 0.8 mm. broad, drying dark green. Leaves of the flowering branchlets much smaller, with 2 to 4 porelike glands at the base of the rachis and occasionally a gland at the apex; pinnae 2 to 5 pairs, consisting of 6 to 12 pairs of leaflets.

Type in the herbarium of the Field Museum of Natural History, no. 58707, collected at the port of Silam (Tsilam), north coast of Yucatan, April, 1895, by Dr. G. F. Gaumer (no. 1909). A second specimen from the same locality is in the same museum, no. 36458, collected by Gaumer (no. 655), apparently at the same time and from the same plant. Photographs and fragments of the type are in the U. S. National Herbarium.

10. **Acacia Donnelliana** sp. nov. Closely related to the preceding, but easily distinguished by its dark-colored polished spines and much longer vegetative leaves. Flower heads globose, long-peduncled, borne in clusters on special flowering branchlets very much as in *A. globulifera*, but with relatively longer and more slender peduncles, the diameter of the heads at anthesis 8 mm., length of longest peduncles 20 mm. Flowers and interfloral bracteoles also much as in the latter species. Fruit not observed. Large spines V-shaped, terete, 40 mm. long, sharply acuminate, those of the type material blackish or dark mahogany-colored, polished. Small spines subtending the flower clusters acicular, much like those of *A. globulifera*, 5 to 7 mm. long. Vegetative leaves with 14 to 18 pairs of pinnae, these 42 to 52 mm. long, composed of 30 to 40 pairs of approximate leaflets; leaflets linear-oblong, very unequal at the truncate base, rounded or subacute at the apex, slightly curved, dark reddish or bronze when dry; leaf rachis 10 to 20 cm. long, puberulent, bearing at its base 4 conoid nectar glands, each opening by a small elliptical pore with a smooth reddish margin, and in addition to these a similar gland at the base of each pair of pinnules. Leaves of flowering branches with several pores at the base of the rachis and a pore at the base of each of the 6 to 15 pairs of pinnae; these leaves sometimes rudimentary or even lacking, in such cases the flower clusters subtended by a pair of small V-shaped acicular spines.

Type in the herbarium of Captain John Donnell Smith, collected at San Pedro de Sula, Department of Santa Bárbara, Honduras, alt. 600 feet, March, 1888, by Dr. Carl Thieme (no. 5216); photograph of type in U. S. National Herbarium.

Section 4. Glomeratae

Flower heads crowded in clusters in the axils of large forked or horn-like stipular spines. Basal nectar gland solitary, much elongate, sunk in the grooved rachis.

11. **Acacia Cookii** Safford, Science, N. S. **31**:677. 1910.

Type in the U. S. National Herbarium, collected at the Finca Trece Aguas, near Secanquím, Alta Verapaz, Guatemala, March 8, 1907, by G. P. Goll (no. 102), supplemented by specimens in alcohol from the same region, collected by O. F. Cook.

12. **Acacia bucerophora** B. L. Robinson, Proc. Am. Acad. **49**: 502. 1913.

Type in the Gray Herbarium, collected in British Honduras, in 1907, by Prof. Morton E. Peck (no. 632). Photograph and fragments of the type are in the U. S. National Herbarium.

GROUP III. LEGUMINIFERAE

(SPICATAE Schenck)

Pericarp dehiscent along both the ventral and the dorsal sutures, coriaceous or woody, relatively short; seeds embedded in a mass of pulp-like aril. Flowers crowded in long spikes on a linear axis, this thicker than the peduncle. Extrafloral nectar glands beadlike, with a round central pore, often present on the rachises of the terminal pinnae as well as upon the petiole of the leaf, but not at the base of each pair of pinnae.

Section 5. Orthocarpae

Pods straight, abruptly pointed or obtuse, tumid or subterete; seeds alternate in 2 rows. Spines usually slender, straight or curved, slightly broadened and compressed at the base.

13. **Acacia yucatanensis** Schenck, Repert. Nov. Sp. Fedde **12**:361. 1913.—Bot. Jahrb. Engler **50**:468. 1914.

Type in the Berlin Herbarium, collected in the forest near Chichen Itza, Yucatan, in May, 1911, by Caec. and Ed. Seler (no. 5549 [470]).

14. **Acacia Collinsii** Safford, Science, N. S. **31**:677. 1910.

Type in U. S. National Herbarium, no. 692159, collected between Chicoasen and San Fernandino, State of Chiapas, southern Mexico, January 14, 1907, by G. N. Collins (no. 180).

Section 6. Acinaceae

Pods scimitar-shaped, or straight along the dorsal and curved along the ventral suture, the apex more or less retrocurved, usually compressed

laterally; seeds in a single row. Spines more or less flattened and broadened at the base, lunate or broadly subdeltoid.

15. **Acacia Nelsonii** sp. nov. Plant with leaves much like those of *A. Collinsii*, but easily distinguished from that species by its light-colored, broadly spreading, upcurved, more or less flattened stipular spines, these about 4 cm. long, 10 mm. broad at base, sometimes lunate or lyre-shaped, smooth, pale olivaceous to tan-colored or buff, with reddish brown tips, becoming gray or whitish when dead. Small spines on flowering branchlets 2 mm. long. Vegetative leaves with 4 to 8 pairs of pinnae; rachis 7 to 12 cm. long, without interpinnal nectar glands but with a row of 3 or 4 glands at the base; pinnae 4.5 to 5.5 cm. long, the leaflets 14 to 19 pairs, uniformly brown when dry, linear-oblong, 8 to 10 mm. long, 2.8 mm. broad, those bearing apical bodies at length retuse or truncate; rachis of pinnae sometimes with a minute solitary terminal gland at the base of the uppermost pair of leaflets. Leaves of flowering branchlets with 1 to 5 pairs of pinnae; rachis bearing at its base a row of 3 glands. Flower spikes 32 to 36 mm. long, including the peduncle, the latter 11 to 13 mm. long, about equal in thickness to the axis of the spike. Interfloral pedicelled bracteoles with orbicular peltate laminae, these imbricated over the flowers before anthesis like the scales of a fish, after anthesis their margins everted and concealed by the mass of anthers. Flowers tubular-funnelform, obovoid, or broadly subcylindrical; calyx 1.2 to 1.3 mm. high, subentire or obtusely 4 or 5-lobed; corolla one-fourth to one-third longer than the calyx, acutely 5 or 6-lobed, the divisions sometimes irregularly cleft; stamens very numerous, the filaments flesh-colored, the anthers straw-colored; style filiform. Legumes small, 2-valved, at length dehiscent by ventral and dorsal sutures, glabrous, dark brown or blackish, compressed, nearly straight along the dorsal suture, curved along the ventral suture, tapering at the base and slightly retrocurved at the apex. Seeds ovoid or elliptical, somewhat compressed but not flattened; testa hard, smooth, dark brown.

Type in the U. S. National Herbarium, no. 399366, collected at Acapulco, State of Guerrero, Mexico, April 30, 1903, by E. W. Nelson (no. 7024), with flowers and fruit. Cotype in the same herbarium, no. 692158, collected in the same locality, in 1895, by Dr. Edward Palmer (no. 390a), without flowers and with a single legume.

16. **Acacia costaricensis** Schenck, Repert. Nov. Sp. Fedde **12**: 361. 1913.—Bot. Jahrb. Engler **50**: 465. 1914.

Type in the Berlin Herbarium, collected near Lepanto, Costa Rica, in January, 1857, by Dr. Carl Hoffmann (no. 275), without fruit. Specimens collected by C. Wright in Nicaragua (U. S. North Pacific Explor. Exped. 1853–56), cited by Schenck as conspecific, are in the Grisebach Herbarium at Göttingen, the Gray Herbarium, and the U. S. National Herbarium (no. 692165), the last with broad flat pods terminating in a sharp retrocurved point.

17. **Acacia penonomensis** sp. nov. Closely related to *Acacia costaricensis*, but with falcate pods, spikes of pale yellow flowers borne on very

slender puberulent peduncles, and relatively broader and shorter leaflets with minute marginal hairs. Spikes before anthesis covered with the pale flesh-colored, scalelike, imbricated, suborbicular limbs of the pedicelled interfloral bracteoles, after anthesis bright lemon yellow from the mass of stamens, 23 to 26 mm. long, 4 to 5 mm. thick, the axis not exceeding in thickness the slender peduncle, this straight and rigid, about 8 mm. long and 0.5 mm. thick, pale brownish, clothed with white puberulence, and bearing a 4-toothed basal involucel, this puberulent outside. Flowers crowded; calyx flesh-colored, broadly ovoid or ellipsoid, inflated, 1.25 mm. high, 1 mm. broad, minutely puberulent about the margin, obscurely 6-lobed or subentire; corolla pale yellow, puberulent, 6-lobed, exceeding the calyx by about one-fourth its length; filaments and anthers pale yellow; style filiform. Legume 2-valved, dehiscent by both dorsal and ventral sutures, curved, compressed, 4.5 cm. long, 1 cm. broad, tapering at the base into a stipe like neck, terminating at the apex in a point. Seeds about 12, in a single row, embedded in a sulphur-yellow pulpy aril, broadly ovoid, 5 mm. long, 4 mm. broad, somewhat compressed into a thick oblique ovoid disk, the testa hard, smooth, glossy dark brown. Large stipular spines reddish brown, becoming blackish, broadly V-shaped or deltoid, 2.6 to 3.2 cm. long, 9 to 11 mm. broad at the base, this inflated and usually compressed, the apex abruptly acuminate and terminating in a very slender, fine point. Spines of the flowering branchlets minute, subulate. Vegetative leaves not observed. Leaves of the flowering branches sometimes rudimentary, the perfect ones composed of 1 to 6 pairs of pinnae; rachis pubescent, 3 to 4.5 cm. long, without interpinnal glands, but with 1 to 3 contiguous pubescent porelike basal glands and usually a similar but smaller terminal gland on the pubescent rachises of the pinnae just beneath the last pair of leaflets, very much as in *A. Collinsii*. Leaflets oblong-obovate, fringed with short hairs.

Type in the Herbarium of the New York Botanical Garden; duplicate in U. S. National Herbarium, no. 677927, collected in the vicinity of Penonomé, Panama, February 23 to March 22, 1908, by R. S. Williams (no. 113).

GROUP IV. FOLLICULARES

Pericarp a follicle, dehiscing by a single suture; seeds in a single row. Leaf rachis with a beadlike nectar gland at the base of each pair of pinnae; nectar glands of the petiole 1 to several, or wanting.

Section 7. **Bursariae** Schenck

Large stipular spines of vegetative branches much flattened and very broad, their bases connate and pocket-like, often resembling an inverted bicorne chapeau. Flowers distinct, not closely crowded, forming a lax linear spike with a slender, often flexible rachis. Pods slender, falcate or curved, compressed, the seeds approximate, inclosed in a thin, whitish or brownish, feltlike aril.

18. **Acacia Hindsii** Benth. Lond. Journ. Bot. **1**: 504. 1842.

Type in the Kew Herbarium, collected on the shore of Manzanillo Bay, State of Colima, Mexico, 1836–39, by Dr. Richard B. Hinds, Surgeon of H. M. S. *Sulphur* (no. 248).

19. **Acacia bursaria** Schenck, Repert. Nov. Sp. Fedde **12**: 363. 1913. —Bot. Jahrb. Engler **50**: 485. 1914.

Type in the Berlin Herbarium, collected near San Felipe, Guatemala, February, 1878, by Bernouilli and Cario (no. 1129).

20. **Acacia sinaloensis** sp. nov. Closely related to *A. Hindsii* Benth. and *A. bursaria* Schenck, but distinguished by its lighter-colored, broadly **V**-shaped or **Y**-shaped spines, these alternate, regularly disposed at intervals of 3 or 4 cm. along the slender, straight, terete, glabrous, reddish brown branches; length of spines 30 to 40 mm., breadth along the suture formed by the connate flattened bases 12 to 14 mm.; extremities terete, tapering into a very sharp point; color of spines usually olivaceous or yellowish green, turning brownish or buff-colored when old and dead. Vegetative leaves fernlike, elliptical or oblong in outline; main rachis grooved above, sparsely pubescent (under the microscope), bearing a raised porelike gland at the base of each pair of pinnae; base of the rachis (petiole) with 1 to 3 similar glands; pinnae 12 to 18 pairs, linear, approximate, their rachises 30 to 34 mm. long, sparsely pubescent; leaflets 5.2 mm. long, 1.4 mm. broad, thin and membranaceous when young, at length subcoriaceous, many of them bearing caducous amber-colored apical bodies, those without the latter acuminate at the apex, the margins of the leaflets bearing very short fine hairs (under the microscope) from the base to the apex, the base very oblique, the midrib conspicuous beneath, the lateral nerves scarcely visible even with the microscope. Leaves of the small axillary branchlets smaller, with fewer pairs of pinnae, these composed of fewer, relatively broader, more rounded leaflets, their rachises provided at the base with a pair of subulate stipular spines, usually without a basal nectar gland, but with one of these at the base of each pair of pinnae. Flowers wanting, but apparently borne in a lax spike. Fruit a falcate or retrocurved follicle dehiscing along the ventral suture, 11 mm. broad near the middle, acuminate at the apex, tapering at the base; seeds 8 to 10, in a single row, embedded in a yellowish white, thin aril, crowded and compressed, oblong or clavate, 8 or 9 mm. long, 4 mm. broad, 2 mm. thick, tapering toward the base into a rounded point, the testa dark brown, hard and polished, with an oblanceolate area enclosed by a raised line on each side.

Type in the U. S. National Herbarium, no. 636818, collected in the vicinity of Villa Unión, State of Sinaloa, Mexico, growing about a pond, April 2, 1910, by Rose, Standley, and Russell (no. 13972).

Section 8. Leiocerates

Large stipular spines of vegetative branches resembling polished subterete spreading horns, somewhat compressed at the connate bases. Smaller spines of the very short axillary branchlets subulate. Leaf

rachis pubescent, bearing a raised nectar gland at the base of each pair of pinnae but (in the type) none on the petiole. Pods of the same general form as in the preceding section but broader and thicker, the seeds enveloped in a thicker aril.

21. **Acacia tepicana** sp. nov. General outline of the bipinate leaves narrowly oblanceolate or oblong, the pinnae short and the leaflets closely crowded. Rachis 6 to 8 cm. long, reddish brown, pubescent, bearing about 14 pairs of pinnae, with a pubescent beadlike or truncate conoid gland at the base of each pair of pinnae, but none at the base of the petiole; pinnae 10 to 18 mm. long, the shortest ones near the base; leaflets 9 to 17 pairs, very small, 4.5 to 6 mm. long, 1.5 mm. broad, oblong, unequal and truncate at the base, acute or short-acuminate at the apex, subcoriaceous, the midrib and lateral nerves inconspicuous, the margins contiguous or overlapping and bearing minute short straight hairs (as seen under the microscope); lowest leaflets much smaller, sometimes rudimentary, bearing a long tapering amber-colored waxlike apical body. Large connate stipular spines broadly V-shaped, subterete, somewhat compressed and broadened at the base, 27 mm. long, 8 or 9 mm. broad at the base, brown, the surface smooth and hornlike. Small spines of the abbreviated rudimentary axillary branchlets subulate, reddish brown. Spikes borne on very short axillary branchlets; peduncles (only those of mature fruiting specimens observed) 8 mm. long, bearing a basal involucel; axis of spike not exceeding the peduncle in thickness. Flowers not observed; interfloral bracteoles short-pedicelled, with a circular disklike peltate limb 1.2 mm. in diameter. Pericarp coriaceous, glabrous, without a definite dorsal suture but sometimes splitting down the back, brown and glabrous outside, reddish and feltlike on the inner surface, compressed, retrocurved, 13 mm. broad in the middle, narrowed at the base into a stipelike neck, long-acuminate at the apex. Seeds 10 to 12, in a single row, ovoid, slightly compressed, about 5.2 mm. long, 4.2 mm. broad, and 4 mm. thick, approximate, embedded in a yellowish white aril having the taste of dried apples; testa olivaceous, hard, smooth and glossy, bearing a raised oval ridge on each side.

Type in the U. S. National Herbarium, no. 637234, collected in the vicinity of Acaponeta, Territory of Tepic, western Mexico, April 10, 1910, by Rose, Standley, and Russell (no. 14357).

GROUP V. HEBACANTHAE

Involucel borne at or above the middle of the peduncle. Large spines puberulent when young, never becoming smooth or polished. Interfloral pedicelled bracteoles not peltate, but with an ovate or fan-shaped limb with a hairy margin.

Section 9. Clavigerae

Flowers crowded in club-shaped, cylindrical, or oblong spikes, covered before anthesis with the imbricated ovoid limbs of the pedicelled brac-

teoles. Peduncles long, straight, slender, puberulent or hirtellous, borne upon axillary flowering branches, solitary or clustered. Large stipular spines straight or nearly so, widespreading, at first puberulent, except at the smooth glossy reddish point, sometimes glabrate in age, but the surface dull and never polished.

22. **Acacia Standleyi** sp. nov. Flower spikes club-shaped, at anthesis, thicker at the apex than at the base, 18 to 22 mm. long, 7 to 8 mm. thick, pubescent before anthesis; peduncles in clusters of 2 to 5, the longest 27 mm. long at anthesis, minutely pubescent below the involucel, the latter 4-toothed, pubescent outside, situated at or above the middle of the peduncle; axis of spike slightly thicker than the peduncle. Flowers with pale yellowish brown or buff, broadly tubular, obtusely lobed calyx and tan-colored, acutely 6-lobed corolla, the latter exceeding the calyx by one-half its length; stamens very numerous, yellow; style filiform. Large spines pubescent at first, with glabrous reddish points, at length dull gray or blackish, 3 to 3.5 cm. long, 6 to 8 mm. broad at the base, very widely divergent, the pair separated by a thickened ridge (the persistent base of the petiole) adnate to the branch. Vegetative leaves with about 25 pairs of pinnae; main rachis pubescent above, about 10 cm. long, with 1 to 3 conspicuous glands at the base and a gland just below each of the 2 or 3 terminal pairs of pinnae, these glands usually with a smooth, light brown, annular margin; pinnae about 2.5 cm. long, those of a pair sometimes not quite opposite; rachis of pinnae pubescent above; leaflets about 30 pairs, approximate, relatively thick and coriaceous, scarcely showing the venation even under the microscope, oblong-linear, 3.2 mm. long, 0.8 mm. broad, unequal at the base, rounded at the apex, sometimes mucronulate or tipped with an apical body, the margin at first bearing a fringe of minute hairs, at length glabrate. Leaves of the axillary flowering branches with 4 to 8 pairs of pinnae composed of 12 to 16 pairs of leaflets, these 2 mm. long, 0.6 mm. broad, when young fringed with hairs, many of them tipped with apical bodies; main rachis bearing a conspicuous annular nectar gland at the base of each pair of pinnae and usually one on the petiole, just below the lowest of these; stipular spines subulate, 4 mm. long.

Type in the U. S. National Herbarium, no. 637251, collected in the vicinity of Acaponeta, Territory of Tepic, western Mexico, April 11, 1910, by Rose, Standley, and Russell (no. 14374).

23. **Acacia hirtipes** sp. nov. Flower spikes oblong or cylindrical, 11 to 15 mm. long, 6 mm. thick, covered before anthesis by the tomentulose laminae of the bracteoles; peduncles densely hirtellous, in clusters of 2 or 3, 14 to 20 mm. long; involucel 4-toothed, hirtellous, situated above the middle of the peduncle; axis scarcely thicker than the peduncle. Flowers with reddish brown or tan-colored calyx resembling that of *A. Standleyi* but narrower at the base and pubescent about the shallowly lobed margin; corolla dark purple or blackish, exceeding the calyx by one-half or three-fourths its length, pubescent with whitish hairs around the 5- or 6-lobed margin; filaments reddish brown; anthers pale tan-

colored; interfloral bracteoles tomentose on the upper surface. Fruit not observed. Large stipular spines broadly V-shaped, cinereous, puberulent except at the points, 3 to 4.2 cm. long, 10 mm. broad at the cuneate base, the latter flattened but not adnate to the branch as in *A. Standleyi*. Spines of the flowering branches subulate, 3 to 6 mm. long, when young strigose except at the polished red tips. Vegetative leaves not observed. Leaves of the flowering branches with 5 to 12 pairs of pinnae composed of 9 to 18 pairs of leaflets, these 2.4 mm. long, 0.8 mm. broad, similar in shape to those of *A. Standleyi* but with a persistent marginal fringe of stiff short straight hairs; rachis persistently and densely hirtellous, clothed with minute stiff whitish hairs; nectar glands dark purplish, circular, bowl-shaped, with a thick annular magin, one in the smaller leaves of the short branchlets one borne at the base of each pair of pinnae and an additional one on the petiole; on the larger leaves of the longer branches similar glands borne at the base of each pair of pinnae of the upper half of the leaf, but none in the lower half except a solitary gland on the petiole.

Type in the U. S. National Herbarium, no. 694036, collected on the Río de las Cañas, Department of Santa Rosa, Guatemala, altitude 3000 feet, April, 1892, by Heyde and Lux (no. 3299, in part; mixed with specimens of *A. bursaria*) under the name of "*A. spadicigera*."

Acacia hirtipes is a shrub with densely cinereous-hirtellous young growth, closely related to *A. Standleyi* but easily distinguished by the dark purplish corolla, the more densely hirtellous indument of the peduncles and leaf rachis, and the persistent marginal hairs of the leaflets.

ABSTRACTS

Authors of scientific papers are requested to see that abstracts, preferably prepared and signed by themselves, are forwarded promptly to the editors. Each of the scientific bureaus in Washington has a representative authorized to forward such material to this journal, and abstracts of official publications should be transmitted through the representative of the bureau in which they originate. The abstracts should conform in length and general style to those appearing in this issue.

AGRICULTURAL CHEMISTRY.—*Aroma of hops: A study of the volatile oil with relation to the geographical sources of the hops.* FRANK RABAK. Journal of Agricultural Research **2**: 115–159. May 25, 1914.

The paper discusses the aroma of hops grown in various parts of the United States and in Bohemia, the basis of comparison being the volatile oil. Factors which influence the aroma of hops, such as climatic conditions and soil, are discussed. Special attention is given to the esters which are the principal odor bearers of the oil. In order that a logical comparison of the various hops may be made, the volatile oils distilled from the several hops are carefully compared as regards their physical and chemical properties. This scheme of comparison is carried through four successive seasons to ascertain whether any constant similarities or differences exist in the oils, especially in the oils distilled from foreign and domestic hops.

Comparisons are made of the yields of volatile oil from the various hops; the physical properties, including color, odor, taste, specific gravity, refraction, and solubility; and the acid, ester, and saponification numbers of the oils. The oils are subsequently fractionated and the properties of the fractions compared. Tables and curves showing the differences in the oils are included.

A detailed chemical examination of a sample of the volatile oil of hops is given and the approximate composition indicated. Important differences in the oils are apparent, not only during any particular season but for several seasons. The curves show these constant differences in properties most forcibly. The curves of ester content show remarkable differences in the oils from the several geographical sources, the imported

oils being consistently lower from year to year in esters to which the characteristic aroma is largely due. The geographical source of hops seems to be indicated by the ester content of the oils. A review of the chemical investigations of the aromatic constituents of hops by other investigators completes the paper. F. R.

GEOLOGY.—*Geology and geography of a portion of Lincoln County, Wyoming.* A. R. SCHULTZ. U. S. Geological Survey Bulletin 543. Pp. 141, with maps, sections, and views. 1914.

Geological formations that outcrop in this area range in age from the Cambrian to the Quaternary. The beds are closely folded and in places overturned. The beds that strike in a north-south direction are exposed in parallel belts throughout the field. Three coal groups have been recognized, ranging in age from Cretaceous to Eocene, and one phosphate group of Carboniferous age.

Tht main disturbances giving rise to the structural features occurred near the close of the Cretaceous, although minor movements have taken place since the deposition of the Eocene beds. Besides the numerous parallel folds and synclines that trend in a north-south direction, the beds have been broken by two parallel thrust faults that lie from 6 to 15 miles apart in an east-west direction and have been traced for a distance of approximately 100 miles in the western part of Wyoming. Along these faults the Carboniferous and Cambrian beds on the west come in contact with beds of Colorado and Montana age on the east.

The economic deposits of greatest importance are the coals. They occur in the Frontier, Adaville, and Evanston formations and belong to beds that are of Colorado, Montana-Laramie, and Eocene age, respectively. The Frontier coal, a high-grade bituminous coal that does not slack on exposure to air, has a heat value of from 12,000 to 14,000 B.t.u. The Adaville and Evanston coals are subbituminous and break down readily on exposure to air. The heat value is considerably less than that of the Frontier coal and ranges from 10,000 to 12,000 B.t.u. The phosphate deposits occur throughout the area near the top of the Carboniferous beds. Gold placers have been worked along Snake River and its tributaries, but on account of the fineness of the gold the placer workings have not been very successful. It requires from 1,000 to 1,200 colors to make a cent value. The richest pay streaks in the gold-bearing sand and gravel lie near bedrock and run from 9 cents to $3.00 per cubic-yard, while some of the material is comparatively barren.

A. R. S.

GEOLOGY.—*Raritan, New Jersey, folio.* W. S. BAYLEY, R. D. SALISBURY, and H. B. KÜMMEL. Geologic Atlas of the United States, No. 191; U. S. Geological Survey. Pp. 32, with sections and 5 maps. 1914.

The area treated is in the center of the Highlands of New Jersey and contains some of the most important magnetite mines of the State. The out-cropping hard rocks embrace pre-Cambrian, Cambrian, Ordovician, Silurian, Devonian, and Triassic sediments, pre-Cambrian and Triassic igneous rocks, and metamorphic pre-Cambrian rocks of undetermined origin. Above these are unconsolidated deposits of Quaternary age.

The pre-Cambrian rocks lie in a series of northeast trending ridges, between which are valleys underlain by Paleozoic beds. These ridges and the intervening valleys constitute the Highlands. The northwest corner of the quadrangle includes a small area of the Kittatinny Valley which borders the Highlands on the north. This is underlain by Cambrian and Ordovician rocks. On the south the Highlands are bordered by the Piedmont plateau which in this area is underlain by Triassic sedimentary formations and associated basalt flows and diabase sheets and dikes.

The Quaternary deposits include glacial material of the Jerseyan and Wisconsin stages, old and recent alluvium and deposits of the glacial Lake Passaic. The terminal moraine of the Wisconsin stage crosses the quadrangle in an east-west direction about six miles from its northside.

The principal economic resources of the quadrangle are magnetic and limonitic iron ores, building stone, crushed rock, and lime rock. Of less importance are clay, sand, gravel, peat, and roofing slate. The water resources are valuable as water supplies and for the development of power. The magnetite, which is by far the most valuable economic product, is regarded as of magmatic origin. The iron is believed to have been contributed by the same magma that formed also the granitoid gneisses and pegmatites that constitute the greater part of the pre-Cambrian rocks. Brief descriptions of the principal mines in the area illustrate the manner of occurrence of the ore. W. S. B.

PALEONTOLOGY.—*Cambrian Geology and Paleontology, II. No. 11.—New Lower Cambrian subfauna.* CHARLES D. WALCOTT. Smithsonian Miscellaneous Collections **57**[11]: 309–326, pls. 50–54. July 21, 1913.

In this paper is described a hitherto unrecognized Lower Cambrian subfauna. It occurs in the Mahto formation (upper portion of the

Lower Cambrian) in the Robson Peak district of the Canadian Rockies. The majority of the species making up the fauna are new and are here described. The new species are referable to the genera Mickwitzia, Lingulella, Obolella, Holmia?, Wanneria, Callavia, and Olenellus.

EDWIN KIRK.

PALEONTOLOGY.—*Cambrian Geology and Paleontology, II. No. 12.—Cambrian formations of the Robson Peak district, British Columbia and Alberta, Canada.* CHARLES D. WALCOTT. Smithsonian Miscellaneous Collections **57**[12]: 327–343, pls. 55–59, figs. 11, 12. July 24, 1913.

The stratigraphic and structural features of the Robson Peak district of the Canadian Rockies are described herein, particular attention being paid to the Cambrian formations and their contained fossils. The Cambrian section as shown in this area includes 12,200 feet of sediments, representing Lower, Middle, and Upper Cambrian. Beneath these beds lie 2,000+feet of Algonkian sandstones and siliceous shales. The section is capped by 3,000 feet of Ordovician.

Several changes are proposed in the geographic nomenclature of the region, and a number of new names are applied to mountains, rivers, and glaciers. Twelve new formation names are proposed for subdivisions of the stratigraphic series. Faunal lists of the different formations are given, and broad correlations are made with the Mount Bosworth Cambrian section. The paper is illustrated with splendid photographs of the Canadian Rockies.

EDWIN KIRK.

PALEONTOLOGY.—*Cambrian Geology and Paleontology, II. No. 13.—Dikelocephalus and other genera of the Dikelocephalinae.* CHARLES D. WALCOTT. Smithsonian Miscellaneous Collections **57**[13]: 345–412, pls. 60–70. April 4, 1914.

The trilobite genus Dikelocephalus which has been a catchall for numerous Upper Cambrian species, is in this paper thoroughly revised; foreign species are removed and referred to their proper genera; and three new genera referable to the subfamily Dikelocephalinae are established. Of the three genera originally referred by Beecher to the Dikelocephalinae only one, Dikelocephalus, is retained. In the subfamily as revised four additional genera are added, Conokephalina Brögger, and three new genera, Saukia, Osceolia, and Calvinella.

In order to show the stratigraphic relationships of the trilobites a provisional classification of the pre-Ordovician formations of the Upper

Mississippi Valley is given. This includes two new formation names. Eau Claire and Mt. Simon (Ulrich MSS., 1914). Numerous faunal lists of these formations and of other Upper Cambrian formations in various parts of the United States which carry Dikelocephalinae are given.

Several new species are described: three under Dikelocephalus, eight under Saukia, and two under Calvinella. *Dikelocephalus lodensis* Whitfield has been chosen as the genotype of Saukia; *Dikelocephalus osceola* Hall, of Osceolia; and *Dikelocephalus spiniger* Hall, of Calvinella. Another new genus, Hungaia, is also established (p. 351) with *Dikelocephalus magnificus* as the genotype. This genus is not subsequently defined and evidently is not referable to the Dikelocephalinae.

EDWIN KIRK.

BACTERIOLOGY.—*The colon group of bacteria.* L. A. ROGERS, WILLIAM M. CLARK, and BROOKE J. DAVIS. Journal of Infectious Diseases **4**: 411–475. May, 1914.

A collection of cultures of the colon type isolated from milk was studied with special reference to the exact determination of the gases formed and the application of these determinations to the classification of the group. It was found that, when determined by exact methods after uniform growth conditions, the volume and relative proportions of the different gases were produced with great uniformity. This character divided the collection into two groups, one of which, characterized by a low volume of gas composed of nearly equal parts of hydrogen and carbon dioxide, corresponds to the *B. coli communis* and *B. coli communior* type. The remaining cultures produce much greater volume of gas and an increasing proportion of carbon dioxide. The increase in the volume of gas was produced almost entirely by increasing quantities of carbon dioxide, while the volume of hydrogen remained nearly constant. In many cultures the ratio of carbon dioxide to hydrogen was nearly or quite 2:1. The variations from the type, as well as the variation in duplicate determinations, were much greater in the latter group. The gas ratio was closely correlated with other physiological reactions, especially the fermentation of carbohydrates and alcohols. The fermentative ability was more pronounced in the high-ratio group, but some particular substances were fermented by a large number of the low-ratio group but by only a few of the high-ratio group. Two possible subdivisions, based on fermentative reactions, could be made in the low-ratio group. It was evident that the high-ratio group was made up of a number of types, but sufficient data for their classification were not available.

L. A. R.

MAMMALOGY.—*The white rhinoceros.* EDMUND HELLER. Smithsonian Miscellaneous Collections **61**[1]: 1–77, plates 1–29, text figs. 1–3, 2 maps. October, 1913.

The first portion of the present paper is devoted to the itinerary of the Smithsonian African Expedition, under the direction of Colonel Roosevelt, and a general description of the Lado Enclave, where the white rhinoceroses were secured, together with a short account of its chief floral features. The systematic part which follows covers 30 pages, in which are comprised: A discussion of the generic characters of the living and extinct forms of rhinoceroses and their probable derivation; dental peculiarities of the white rhinoceros; subspecific characters of the Nile race; and a description of its coloration, external form, size, geographical range, and habits, as well as a history of its discovery. In the following 10 pages Colonel Roosevelt's account of the shooting and field natural history of the species is quoted. Several pages are then devoted to a complete bibliography, followed by twenty pages of explanatory matter referring to the plates of skulls. The numerous illustrations consist of 8 plates showing the country, natives, and floral features; 5 views of white rhinoceroses in the flesh; 2 of live specimens taken on the shooting grounds; and 2 of mounted specimens in the National Museum. The 20 plates of skulls consist of 99 separate figures illustrating all the specimens collected by the expedition, besides specimens of related genera in the British Museum, U. S. National Museum and other institutions. Of the two maps one illustrates the distribution of the species throughout its whole African range, and the other the distribution of the Nile race in the Lado Enclave of the Upper Nile region.

The white rhinoceros, because of its remarkably elongate skull and the highly specialized structure of its cheek-teeth, is treated as a distinct generic type and the sole representative of the genus Ceratotherium. The Nile form, *Cottoni*, was originally described as a species, but a comparison of the large series of specimens now in the National Museum with the South African specimens preserved in European museums has shown it to be only a rather slight subspecies characterized chiefly by the somewhat flatter dorsal outline of its skull, this notwithstanding that the two forms are separated by 1000 miles of territory and have doubtless been thus separated for a great length of time.

Zoologists have usually considered the white rhinoceros as a close blood relative of the recently extinct woolly rhinoceros of northern Europe, but a comparative study of the skulls of the two shows them to be funda-

mentally different and to resemble one another only superficially, in the structure of the teeth. None of the known fossil forms of Eurasia and America are considered as generically identical with the white rhinoceros, which is regarded by the author as a form of African derivation.

E. H.

ENTOMOLOGY.—*Type species of the genera of ichneumon flies.* HENRY L. VIERECK. Bulletin of the U. S. National Museum, No. 83. Pp. 1–186. January 31, 1914.

In the present work the author has listed the genera of the superfamily Ichneumonoidea and has given the original reference for each genus, the number of species originally included, and the type of the genus, or, if the genus was based on more than one species without specifying a genotype, the reference to the work in which the type was first fixed. Genera based on one species only are indicated as monobasic; wherever two or more were found to have the same species as genotype the fact is indicated by the term isogenotypic. Many genera, when originally described, had no species included, in which case there is given the citation for the first species subsequently included; or, if more than one were simultaneously included, the number is given and the treatment is similar to that of the other genera.

In completing this work, it was found that certain generic names were being used in a sense different from that of the original describer and it thus became necessary to propose the following: Chorebidea for Chorebus of authors, not of Haliday; Deuteroxorides for Xorides of authors, not of Latreille; Diclosterocerus for Closterocerus Hartig, not of Westwood; Helconidea for Helcon of authors, not of Nees; Ischnopsidea for Ischnus of authors, not of Gravenhorst; Mesostenidea for Mesostenus of authors, not of Gravenhorst; Myiarthridea for Myiarthrus of authors, not of Foerster; Pimplidea for Pimpla of authors, not of Fabricius; Plectiscidea for Plectiscus of authors, not of Gravenhorst; Plesiophthalmidea for Plesiophthalmus Ashm., not of Foerster; Porizonidea for Porizon of authors, not Fallen; Zavipio for Vipio of authors, not of Latreille.

J. C. CRAWFORD.

REFERENCES

Under this heading it is proposed to include, by author, title, and citation, references to all scientific papers published in or emanating from Washington. It is requested that authors coöperate with the editors by submitting titles promptly, following the style used below. These references are not intended to replace the more extended abstracts published elsewhere in this JOURNAL.

OCEANOGRAPHY

CLARK, A. H. *The circulation of the abyssal waters of the oceans, as indicated by the geographical and bathymetrical distribution of the recent crinoids.* Bulletin de l'Institut Océanographique (Fondation Albert Ier, Prince de Monaco), No. 285, pp. 1–27. February 25, 1914. (A preliminary presentation of the subject matter of this paper has already appeared in this journal, vol. 4, no. 1, pp. 1–3.—A.H.C.)

CHEMISTRY

CHAPIN, R. M. Laboratory and field assay of arsenical dipping fluids. Bulletin of the U. S. Department of Agriculture, No. 76. Pp. 1–17, April 29, 1914. (Methods of analysis for determining the arsenical content of fluids used for dipping cattle in the eradication of the Texas-fever tick.—C.S.S.)

COOK, F. C. *Bouillon cubes; their contents and food value compared with meat extracts and home-made preparations of meat.* Bulletin of the U. S. Department of Agriculture, No. 27. Pp. 1–7. November 5, 1913.

HAWKINS, L. A. *The effect of certain chlorides singly and combined in pairs on the activity of malt diastase.* Botanical Gazette **55**: 265–285. April 15, 1913.

AGRONOMY

ARNOLD, J. H. *Crew work, costs, and returns in commercial orcharding in West Virginia.* Bulletin of the U. S. Department of Agriculture, No. 29. Pp. 1–24. November 21, 1913.

BECKETT, S. H. *Progress report of coöperative irrigation experiments at California University Farm, Davis, Cal., 1909–1912.* Bulletin of the U. S. Department of Agriculture, No. 10. Pp. 1–21. October 30, 1913. (Reports results of using varying quantities of irrigation water on various farm crops. —C. S. S.)

BURRITT, M. C., and BARRON, J. H. *An example of successful farm management in southern New York.* Bulletin of the U. S. Department of Agriculture, No. 32. Pp. 1–24. November 22, 1913.

CARDON, P. V. *Cereal investigations at the Nephi substation.* Bulletin of the U. S. Department of Agriculture, No. 30. Pp. 1–50. November 25, 1913.

CHAMPLIN, M. *Experiments with wheat, oats, and barley in South Dakota.* Bulletin of the U. S. Department of Agriculture, No. 39. Pp. 1–37. January 20, 1914.

CHUBBUCK, L. *Possible agricultural development in Alaska.* Bulletin of the U. S. Department of Agriculture, No. 50. Pp. 1–31. January 8, 1914.

COOK, O. F. *The relation of cotton buying to cotton growing.* Bulletin of the U. S. Department of Agriculture, No. 60. Pp. 1–21. February 16, 1914.

COVILLE, F. V. *The agricultural utilization of acid lands by means of acid-tolerant crops.* Bulletin of the U. S. Department of Agriculture, No. 6. Pp. 1–13. September 19, 1913. (A discussion of the source and effect of soil acidity and of crops and rotations suited to acid lands.—C. S. S.)

HUNTER, B. *Pasture and grain crops for hogs in the Pacific northwest.* Bulletin of the U. S. Department of Agriculture, No. 68. Pp. 1–27. February 25, 1914.

KEARNEY, T. H. *Seed selection of Egyptian cotton.* Bulletin of the U. S. Department of Agriculture, No. 38. Pp. 1–8. November 19, 1913.

MATHEWSON, E. H. *The culture of flue-cured tobacco.* Bulletin of the U. S. Department of Agriculture, No. 16. Pp. 1–36. October 22, 1913.

MOWRY, H. H. *A normal day's work for various farm operations.* Bulletin of the U. S. Department of Agriculture, No. 3. Pp. 1–44. September 23, 1913. (Gives data compiled from reports secured by correspondence with farmers in various sections of the United States.—C. S. S.)

ORTON, W. A. *Lessons for American potato growers from German experiences.* Bulletin of the U. S. Department of Agriculture, No. 47. Pp. 1–12. November 25, 1913.

SHERMAN, W. A., and others. *Studies of primary cotton market conditions in Oklahoma.* Bulletin of the U. S. Department of Agriculture, No. 36. Pp. 1–36. November 15, 1913.

THOMSON, E. H., and DIXON, H. M. *A farm-management survey of three representative areas in Indiana, Illinois, and Iowa.* Bulletin of the U. S. Department of Agriculture, No. 41. Pp. 1–42. January 14, 1914.

TURRENTINE, J. W. *Nitrogenous fertilizers obtainable in the United States.* Bulletin of the U. S. Department of Agriculture, No. 37. Pp. 1–12. December 8, 1913.

WAGGAMAN, W. H. *A report on the phosphate fields of South Carolina.* Bulletin of the U. S. Department of Agriculture, No. 18. Pp. 1–12. October 1, 1913.

BACTERIOLOGY

AYRES, S. H., and JOHNSON, W. T. *Pasteurization in bottles and the process of bottling hot pasteurized milk.* Journal of Infectious Diseases **14**: 217–241. March, 1914.

BOWEN, J. T. *The cost of pasteurizing milk and cream.* Bulletin of the U. S. Department of Agriculture, No. 85. Pp. 1–12. April 27, 1914.

CURRIE, J. N. *Flavor of roquefort cheese.* Journal of Agricultural Research **2**: 1–14. April 15, 1914.

KELLERMAN, K. F. *Soil bacteriology as a factor in crop production.* Bureau of Plant Industry Circular 113: 3–10, fig. 1. February 15, 1913.

KELLERMAN, K. F. *Testing cultures of nodule-forming bacteria.* Bureau of Plant Industry Circular 120: 3–5, fig. 1. April 5, 1913.

KELLERMAN, K. F. *The use of congo red in culture media.* Bureau of Plant Industry Circular 130: 15–17. June 21, 1913.

KELLERMAN, K. F., and LEONARD, L. T. *The prevalence of* Bacillus radicicola *in soil.* Science II. **38**: 95–98. July 18, 1913.

KELLEY, E. *Medical milk commissions and certified milk.* Bulletin of the U. S. Department of Agriculture, No. 1. Pp. 1–38. September 17, 1913.

MCBETH, I. G., and SCALES, F. M. *The destruction of cellulose by bacteria and filamentous fungi.* Bureau of Plant Industry Bulletin 266: 9–52, pls. 1–4. February 21, 1913.

ROGERS, L. A. and DAHLBERG, A. O. *The origin of some of the streptococci found in milk.* Journal of Agricultural Research **1**: 491–511, figs. 1–8. March 25, 1914.

PHYTOPATHOLOGY

ALLARD, H. A. *The mosaic disease of tobacco.* Bulletin of the U. S. Department of Agriculture, No. 40. Pp. 1–33. January 15, 1914.

HARTLEY, C. *The blights of coniferous nursery stock.* Bulletin of the U. S. Department of Agriculture, No. 44. Pp. 1–21. December 12, 1913.

JOHNSON, E. C. *A study of some imperfect fungi isolated from wheat, oat, and barley plants.* Journal of Agricultural Research **1**: 475–490, pls. 62, 63. March 25, 1914.

MCMURRAN, S. M. *The anthracnose of the mango in Florida.* Bulletin of the U. S. Department of Agriculture, No. 52. Pp. 1–15. January 24, 1914.

MELHUS, I. E. *Powdery scab* (Spongospora subterranea) *of potatoes.* Bulletin of the U. S. Department of Agriculture, No. 82. Pp. 1–16. April 6, 1914.

ORTON, W. A. *Potato wilt, leaf-roll, and related diseases.* Bulletin of the U. S. Department of Agriculture, No. 64. Pp. 1–48. February 10, 1914.

ORTON, W. A. *The potato quarantine and the American potato industry.* Bulletin of the U. S. Department of Agriculture, No. 81. Pp. 1–20. March 31, 1914.

PLANT PHYSIOLOGY

BALLARD, W. S., and VOLCK, W. H. *Winter spraying with solutions of nitrate of soda.* Journal of Agricultural Research **1**: 437–444, pls. 50, 51. February, 1914.

BRIGGS, L. J., and SHANTZ, H. L. *The water requirements of plants. I. Investigations in the Great Plains in 1910 and 1911.* Bureau of Plant Industry Bulletin 284: 5–49, pls. 1–11, figs. 1 and 2. October 16, 1913. *II. A review of the literature.* Bureau of Plant Industry Bulletin 285: 5–96, figs. 1–6. October 6, 1913.

GARNER, W. W., and others. *Research studies on the curing of leaf tobacco.* Bulletin of the U. S. Department of Agriculture, No. 79. Pp. 1–40. April 23, 1914.

LECLERC, J. A., and YODER, P. A. *Environmental influences on the physical and chemical characteristics of wheat.* Journal of Agricultural Research **1**: 275–291. January, 1914.

SHANTZ, H. L. *The effects of artificial shading on plant growth in Louisiana.* Bureau of Plant Industry Bulletin 279: 5–31, pls. 1–6, figs. 1–11. April 16, 1913.

ZOOLOGY

BARBOUR, T. *Reptiles and amphibians from eastern Sudan.* Proceedings of the Biological Society of Washington **26**: 145–150. June 30, 1913. (Includes description of one new reptile, *Atractaspis Phillipsi.*—W.R.M.)

BIGELOW, H. B. *Medusae and Siphonophorae collected by the U. S. Fisheries steamer "Albatross"* in the northwestern *Pacific, 1906.* Proceedings of the U. S. National Museum **44**: 1–119, pls. 1–6. March 26, 1913.

COCKERELL, T. D. A. *A peripatus from Guatemala.* Proceedings of the Biological Society of Washington **26**: 87, 88. May 3, 1913. (Describes *Peripatus* (Epiperipatus) *Biolleyi Betheli*, var. nov.—W.R.M.)

CUSHMAN, J. A. *A monograph of the Foraminifera of the north Pacific Ocean: Part IV. Chilostomellidae, Globigerinidae, Nummulitidae.* Bulletin 71, U. S. National Museum. Pp. i–vi, 1–46, pls. 1–19. February 28, 1914. (Nearly all of the species treated are elaborately figured; none is described as new.—W.R.M.)

FISHER, W. K. *Four new genera and fifty-eight new species of starfishes from the Philippine Islands, Celebes, and the Moluccas.* Proceedings of the U. S. National Museum **43**: 599–648. February 5, 1913. (The four new genera are: Ctenopleura and Astromesites, of the family Astropectinidae; Perissogonaster and Astrothauma, of the family Goniasteridae.—W.R.M.)

FOOTE, J. S. *The comparative histology of the femur.* Smithsonian Miscellaneous Collections **61**[8]: 1–9, pls. 1–3. August 22, 1913.

GEROULD, J. H. *The sipunculids of the eastern coast of North America.* Proceedings of the U. S. National Museum **44**: 373–437, pls. 58–62. April 12, 1913.

HARRING, H. K. *Synopsis of the Rotatoria.* Bulletin 81, U. S. National Museum. Pp. 1–226. June 28, 1913.

LINTON, E. *Notes on a viviparous distome.* Proceedings of the U. S. National Museum **46**: 551–555, pl. 43. February 24, 1914. (Describes *Parorchis avitus*, sp. nov., obtained from a herring gull, *Larus argentatus*, in Massachusetts.—W.R.M.)

MARSH, C. D. *Report on fresh-water Copepoda from Panama, with descriptions of new species.* Smithsonian Miscellaneous Collections **61**[3]: 1–31, pls. 1–5. June 20, 1913. (Includes descriptions of 7 new species in Cyclops, Diaptomus, and Pseudodiaptomus.—W.R.M.)

MCMURRICH, J. P. *Description of a new species of actinian of the genus Edwardsiella from southern California.* Proceedings of the U. S. National Museum **44**: 551–553. April 18, 1913.

RATHBUN, MARY J. *Descriptions of new species of crabs of the families Grapsidae and Ocypodidae.* Proceedings of the U. S. National Museum **46**: 353–358, pls. 30–33. December 31, 1913. (Contains descriptions of 4 new species of Indo-Pacific crabs.—M.J.R.).

RATHBUN, MARY J. *New species of crabs of the families Grapsidae and Ocypodidae. (Scientific results of the Philippine cruise of the Fisheries steamer "Albatross," 1907–1910.—No. 31).* Proceedings of the U. S. National Museum **47**: 69–85. May 7, 1914.

RATHBUN, MARY J. *New genera and species of American brachyrhynchous crabs.* Proceedings of the U. S. National Museum **47**: 117–129, pls. 1–10. May 20, 1914. (Describes three new genera of Goneplacidae, six new species of Grapsidae, and two new species of Ocypodidae.—M.J.R)

RICHARDSON, HARRIET. *The isopod genus* Ichthyoxenus *Herklots, with description of a new species, from Japan.* Proceedings of the U. S. National Museum **45**: 559–562, text figs. 1–6. June 4, 1913.

RUTHVEN, A. G. *Description of a new Uta from Nevada.* Proceedings of the Biological Society of Washington **26**: 27–30, fig. 1. Feb. 8, 1913. (Describes *Uta Stansburiana nevadensis*, subsp. nov.—W.R.M.)

STEJNEGER, L. *A new lizard from Porto Rico.* Proceedings of the Biological Society of Washington **26**: 69–72. March 22, 1913. (Describes *Ameiva Wetmorei*, sp. nov.—W.R.M.)

STEJNEGER, L. *Results of the Yale-Peruvian expedition of 1911. Batrachians and reptiles.* Proceedings of the U. S. National Museum **45**: 541–547. June 4, 1913. (Includes descriptions of three new amphibians and two new reptiles from Peru.—W.R.M.).

THOMPSON, HELEN B. *Description of a new subspecies of* Rana pretiosa *from Nevada.* Proceedings of the Biological Society of Washington **26**: 53–56, fig. 2. March 22, 1913. (Describes *Rana pretiosa luteiventris*, subsp. nov.—W.R.M.).

WILSON, C. B. *Crustacean parasites of West Indian fishes and land crabs, with descriptions of new genera and species.* Proceedings of the U. S. National Museum **44**: 189–277, pls. 18–53. April 3, 1913.

ENTOMOLOGY

JOHNSON, F. *The grape leafhopper in the Lake Erie valley.* Bulletin of the U.S. Department of Agriculture, No. 19. Pp. 1–47, pls. 1–3. January 24, 1914. (A professional paper dealing with the life-history and habits of this species. *Typhlocyba comes* Say, its parasites and predaceous enemies, natural checks, and artificial methods of control; includes also a bibliography.—J.C.C.)

MORGAN, A. C., and CRUMB, S. E. *The tobacco splitworm.* Bulletin of the U. S. Department of Agriculture, No. 59. Pp. 1–7. January 19, 1914. (A short account of the immature stages, life-history and food-habits of *Phthorimaea operculella* Zeller, with remedial measures.—J.C.C.)

TOWNSEND, C. H. T. *New muscoid flies, mainly Hystriciidae and Pyrrhosiinae from the Andean Montanaya, (continuation.)* Insecutor Inscitiae Menstruus **2**: 29–32. February 28, 1914. (Describes two new species and the new genera Eurythiopsis and Corpulentosoma.—J.C.C.)

PATHOLOGY

MOHLER, J. R. *Cerebrospinal meningitis ("forage poisoning").* Bulletin of the U. S. Department of Agriculture, No. 65. Pp. 1–14. February 14, 1914.

MOHLER, J. R., and EICHHORN, A. *Immunization tests with glanders vaccine.* Bulletin of the U. S. Department of Agriculture, No. 70. Pp. 1–13. April 15, 1914.

MOHLER, J. R., EICHHORN, A., and BUCK, J. M. *The diagnosis of dourine by complement fixation.* Journal of Agricultural Research, **1**: 99–107. November, 1913.

RANSOM, B. H. Cysticercus ovis, *the cause of tapeworm cysts in mutton.* Journal of Agricultural Research **1**: 15–57, fig. 1–13, pl. 2–4. October, 1913.

ANTHROPOLOGY

HENDERSON, J., and HARRINGTON, J. P. *Ethnozoology of the Tewa Indians.* Bureau of American Ethnology, Bulletin 56. Pp. i–x, 1–76. 1914.

HOLMES, W. H. *Remarks [on the relation of archeology to ethnology].* Amer. Anthropologist, n.s., **15**: 566, 567. October–December, 1913 [pub. 1914].

MICHELSON T. *Notes on the social organization of the Fox Indians.* Amer. Anthropologist, n.s., **15**: 691–693. October–December, 1913 [pub. 1914].

MICHELSON, T. *Notes on Algonquian grammar.* Amer. Anthropologist, n.s., **15**: 693–695. October–December, 1913 [pub. 1914].

MICHELSON, T. *Notes on the Folklore and mythology of the Fox Indians.* Amer. Anthropologist, n.s., **15**: 699, 700. October–December, 1913 [pub. 1914].

SWANTON, J. R. *Results of some recent investigations regarding the southeastern tribes of the United States.* Amer. Anthropologist, n.s., **15**: 690, 691. October–December, 1913 [pub. 1914].

TECHNOLOGY

COBB, N. A. *Tests of the waste, tensile strength, and bleaching qualities of the different grades of cotton as standardized by the United States Government.* Bulletin of the U. S. Department of Agriculture, No. 62. Pp. 1–8. January 14, 1914.

DUVEL, J. W. T., and DUVAL, L. *The shrinkage of shelled corn while in cars in transit.* Bulletin of the U. S. Department of Agriculture, No. 48. Pp. 1–21. December 19, 1913.

NEWLIN, J. A. *Tests of wooden barrels.* Bulletin of the U. S. Department of Agriculture, No. 86. Pp. 1–12. March 14, 1914.

OKEY, C. W. *The wet lands of southern Louisiana and their drainage.* Bulletin of the U. S. Department of Agriculture, No. 71. Pp. 1–82. April 30, 1914.

PENNINGTON, MARGARET E., and others. *The Refrigeration of dressed poultry in transit.* Bulletin of the U. S. Department of Agriculture, No. 17. Pp. 1–35. November 5, 1913.

STUBENRAUCH, A. V., and MANN, C. W. *Factors governing the successful storage of California table grapes.* Bulletin of the U. S. Department of Agriculture, No. 35. Pp. 1–31. December 31, 1913.

STUBENRAUCH, A. V., and others. *Factors governing the successful shipment of oranges from Florida.* Bulletin of the U. S. Department of Agriculture, No. 63. Pp. 1–50. March 28, 1914.

TRULLINGER, R. W. *Water supply, plumbing, and sewage disposal for country homes.* Bulletin of the U. S. Department of Agriculture, No. 57. Pp. 1–46. February 21, 1914.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

THE GEOLOGICAL SOCIETY OF WASHINGTON

The 285th meeting was held at the Cosmos Club, May 13, 1914.

INFORMAL COMMUNICATIONS

A barite deposit on Castle Island, Duncan Canal, Alaska: E. F. BURCHARD.

Andradite and gedrite from a contact metamorphic zone in the Washington-Duquesne camp, Arizona: F. C. SCHRADER.

A microscopic method of measuring the refractive indices of liquids: FRED. E. WRIGHT (See this Journal **4**: 269–279. June 4, 1914.)

REGULAR PROGRAM

The oxidized zinc ores of Leadville, Colorado: G. F. LOUGHLIN. No abstract. (This paper will form a chapter in a monograph on the Leadville district to be published by the U. S. Geological Survey.)

Some geodetic evidence of isostasy: WILLIAM BOWIE. The speaker gave a brief summary of the results of the investigations by the Coast and Geodetic Survey during the last few years dealing with the figure of the earth and with gravity reductions. He pointed out the great increase in the accuracy of the results due to the introduction of the theory of isostasy. By this means Hayford was able to determine the figure of the earth with greater precision than had been obtained previously.

Especial attention was called to an illustration in Hayford's second report on investigations concerning the figure of the earth in which are shown areas of excess and deficiency of mass, as indicated by the deflection anomalies. It was stated that a gravity station was placed in or near 13 of the 16 areas indicated and, in each case, the gravity results agreed with those of the deflections. The results of the recent gravity investigations prove conclusively that there is no definite relation between the character of the topography and the sign and size of the gravity anomalies if the reduction is made by the Hayford method. If the Bouguer or rigid method of reduction is used there is a decided relation between the topography and the size and sign of the anomalies.

The data at hand do not show whether regional or local distribution of compensation is nearer the truth. The reduction by both methods of the distribution has been made by the Coast and Geodetic Survey, but the results are negative.

A preliminary computation of the depth of compensation was made in the Survey, using gravity observations alone. The results were not entirely satisfactory, as the determination was weak. The speaker stated that the geodetic evidence shows definitely that large areas, such as that of the United States, are perfectly compensated on an average and that areas very much smaller than the United States are also in a nearly perfect state of isostasy. It will need further and extensive geodetic observations to determine the minimum area which may be completely, or in large part, in a state of isostasy.

Stratigraphy of the Montana group (Upper Cretaceous) in northwestern Montana and its relation to the Belly River beds and Judith River formation: EUGENE STEBINGER. The section of the Montana group, in northwestern Montana, as exposed on Two Medicine River between its mouth and Family post office, was found to differ considerably from the standard section of the Montana group for central Montana, which, as described by Stanton and Hatcher in 1903, in connection with their stratigraphic study of the Judith River formation, includes the Eagle, Claggett Judith River, and Bearpaw formations. The section on Two Medicine River was readily divided into four lithologic units, which from the base upwards are as follows: (1) Virgelle sandstone, a coarse gray to buff sandstone 220 feet thick, resting on Colorado shale; (2) Two Medicine formation, a rudely bedded mass of light colored clays and sandstones, chiefly fresh water in origin, 1950 feet thick; (3) Bearpaw shale, a dark marine clay shale, 500 feet thick; (4) Horsethief sandstone, a coarse gray to buff sandstone 360 feet thick. These four stratigraphic units were traced northward into the area in southern Alberta containing the Belly River beds as described by G. M. Dawson, of the Canadian Geological Survey. The Belly River beds were found to be equivalent to all of the strata included in the Virgelle sandstone and Two Medicine formation. On the other hand, by tracing the formations in the section on Two Medicine River eastward to central Montana, the Virgelle sandstone was found to be equivalent to the massive sandstone member forming the lower part of the Eagle sandstone, while the Bearpaw shale appeared to be the same at each locality. It thus became apparent that the marine shale of the Claggett formation thins out in going westward from the central part of the State, so that the Two Medicine formation is equivalent to all of the strata in central Montana included in the Judith River, Claggett, and the upper part of the Eagle formations. The Belly River beds of Dawson are therefore not identical and equivalent to the Judith River formation, as has been stated by Stanton and Hatcher, but are equivalent to all of the Eagle, Claggett, and Judith River formations combined.

A diagram of the lithologic units of the Montana group in this region was presented, outlining the sections described and also the section of the Montana group from the Black Hills region, the rocks which are mainly continental in origin being graphically indicated as distinct from those that are chiefly marine. The interfingering of the sheets of the continental sediments from the west with the marine sediments from the east

during each of the major oscillations of the western shore line of the Montana sea, together with the inference that the important sandstones in the Montana group were laid down as near-shore or beach sands, and only during recessions of the sea, was pointed out on the diagram.

FRANK L. HESS, *Secretary.*

THE BOTANICAL SOCIETY OF WASHINGTON

The ninety-seventh regular meeting of the Botanical Society of Washington was held in the Assembly Hall of the Cosmos Club, Tuesday, May 5, 1914, at 8 P.M. Messrs. P. V. Cardon, G. P. Van Eseltine, and A. B. Clawson were elected to membership.

The scientific program was as follows:

PROF. CHAS. O. APPLEMAN, *The physiology of the rest period in the potato tuber* (with lantern). (To be published as a Maryland State Experiment Station Bulletin.)

DR. H. B. HUMPHREY, *A recently discovered loose smut of rye* (with lantern). (To be published in Phytopathology.)

MR. L. H. DEWEY, *The common names of plant fibers.* Confusion in the names of textile fibers of vegetable origin causes uncertainty, financial loss, and injury to the trade. The name "hemp" and its forms in other languages is the oldest name used to designate a plant fiber. This name is now used in many languages as a specific term to designate the true hemp, *Cannabis sativa,* to which in all instances it was first applied, and also as a generic term to designate all long fibers. This double use is confusing. The name sisal is also being used in a similar double sense.

The following suggestions are made regarding the choice of names of fibers: (1) Names in most general use are to be preferred, providing they are not misleading; (2) the same term should not be used to designate fibers from different kinds of plants; (3) one name should be used to designate the fiber from one kind of plant, irrespective of the country in which the plant is cultivated or the manner in which the fiber is prepared; (4) geographic names are objectionable in general terms; (5) names that may be adopted directly in all languages are desirable; (6) single words of not more than three syllables are best.

P. L. RICKER, *Corresponding Secretary.*

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